

Accuracy Characteristics for ZME Risk Reduction Scenario Hours 2100-2330

1 Introduction

This document contains scenario characteristics for hours 2100 to 2330 GMT recorded on October 5, 2000 at Memphis ARTCC (ZME). Characteristics to be provided are general statistics determined from the scenario on airspace characteristics, aircraft to aircraft and aircraft to airspace encounters, general air traffic, aircraft, and flight plan adherence. Definitions of the provided scenario characteristics are provided in Reference[1].

2 Reference

[1] Paglione, M., Oaks, R., Ryan, Dr. H., Summerill, J.S., (Final, January 2000), *Description of Accuracy Scenarios for the Acceptance Testing of the User Request Evaluation Tool (URET) / Core Capability Limited Deployment (CCLD)*, FAA William J. Hughes Technical Center / ACT-250, Atlantic City, New Jersey.

NOTE – Section numbers in this document do not map to those of the reference document.

3 Center Airspace

This section corresponds to Section 3.1 of Reference[1]. The below data corresponds to the ZME Center using the October 5, 2000 ACES chart cycle. Information provided in Table 1 was gathered from running URET PRE and local knowledge.

Table 1: Center Airspace Characteristics

Metric	Definitions	Count
Airports	From URET DU Adaptation List	778
Sectors	From URET DU Adaptation List	110
SAA	Special Activities Airspace	57
APDIA	Automated Problem Detection Inhibited Area	10
SID	Standard Instrument Departure	11
STAR	Standard Arrival Route	10
PAR	Preferential Arrival Route	594
PDR	Preferential Departure Route	346
PDAR	Preferential Departure Arrival Route	124

4 Aircraft Encounter Distributions

The statistics collected in this section characterize aircraft to aircraft encounters. The encounter counts are partitioned by selected minimum horizontal separation intervals, a count of encounters partitioned by standard flight levels, and by vertical phase of flight and aircraft encounter angle. This section corresponds to Section 3.2.1 in Reference[1].

4.1 Count Partitioned by Minimum Horizontal Separation

This section corresponds to Section 3.2.1.1 in Reference[1].

Table 2: Count of Current Plan Aircraft Encounters

Min. Horz. Separation (nm)	Without Adherence	13 Minutes Adherence
$0 \leq d < 5$	50	35
$5 \leq d < 10$	58	42
$10 \leq d < 15$	85	55
$15 \leq d < 23$	136	91
$23 \leq d < 30$	129	83
Total	458	306

Table 3: Count of Trial Plan Aircraft Encounters

Min. Horz. Separation (nm)	Without Adherence	20 minutes Adherence
$0 \leq d < 5$	50	33
$5 \leq d < 10$	58	41
$10 \leq d < 15$	85	50
$15 \leq d < 24$	160	105
$24 \leq d < 30$	105	64
Total	458	293

4.2 Count Partitioned by Altitude for Standard Separation Intervals

This section corresponds to Section 3.2.1.2 of Reference[1].

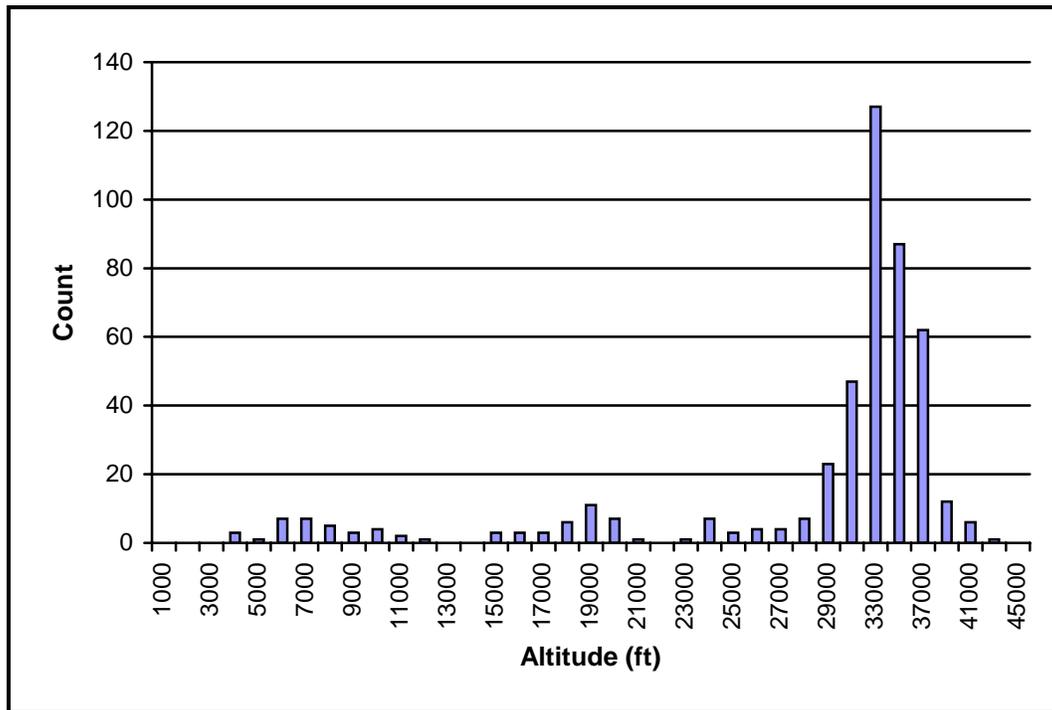


Figure 1: Aircraft to Aircraft Encounters by Altitude

4.3 Count Partitioned by Vertical Phase of Flight and Encounter Angle

This section corresponds to Section 3.2.1.3 of Reference[1].

Table 4: Count of Aircraft Encounters Partitioned by Phase of Flight and Encounter Angle

Vertical Phase	Encounter Angles (deg)				Total
	[0, 45)	[45, 90)	[90, 135)	[135, 180]	
Cruise-Cruise	65	71	34	20	190
Descend-Descend	5	3	3	2	13
Climb-Climb	10	0	4	3	17
Cruise-Climb	37	30	15	20	102
Cruise-Descend	36	25	18	23	102
Climb-Descend	8	4	3	4	19
Unknown	13	2	0	0	15
Total	174	135	77	72	458

5 Airspace Encounter Distributions

This section provides statistics on aircraft to airspace encounters. Three areas considered are counts partitioned by selected minimum horizontal separation intervals, an encounter count partitioned by standard flight levels, and a count partitioned by vertical phase of flight and airspace encounter angle. Additionally, vertical phase of flight count is separated into top, bottom and side airspace encounters and for encounters with unknown encounter angles. The section corresponds to Section 3.2.2 of Reference[1].

5.1 Count Partitioned by Minimum Horizontal Separation

The section corresponds to Section 3.2.2.1 of Reference[1].

Table 5: Count of Current Plan Airspace Encounters by Horizontal Separation

Min. Horz. Separation (nm)	Without Adherence	13 minutes Adherence
Conflicts ¹	189	158
$d = 0^2$	8	7
$0 < d < 7$	193	133
$7 \leq d < 9$	38	26
$9 \leq d < 11$	38	21
$11 \leq d < 16$	109	75
$16 \leq d < 30$	359	253
Total	934	673

Table 6: Count of Trial Plan Airspace Encounters by Horizontal Separation

Min. Horz. Separation (nm)	Without Adherence	20 minutes Adherence
Conflicts ³	189	155
$d = 0^4$	8	7
$0 < d < 8$	220	151
$8 \leq d < 11$	49	28
$11 \leq d < 13$	45	29
$13 \leq d < 19$	147	101
$19 \leq d < 30$	276	190
Total	934	661

¹ This count includes encounters that are conflicts. By definition the minimum horizontal separation is zero and the track point actually penetrates the airspace.

² This count includes encounters without valid airspace penetrations, which occurs under two cases: a short duration penetration or an encounter on the actual buffered boundary of the airspace which does not penetrate.

³ This count includes encounters that are conflicts. By definition the minimum horizontal separation is zero and the track point actually penetrates the airspace.

⁴ This count includes encounters without valid airspace penetrations, which occurs under two cases: a short duration penetration or an encounter on the actual buffered boundary of the airspace which does not penetrate.

5.2 Count Partitioned by Altitude

This section corresponds to Section 3.2.2.2 of Reference[1].

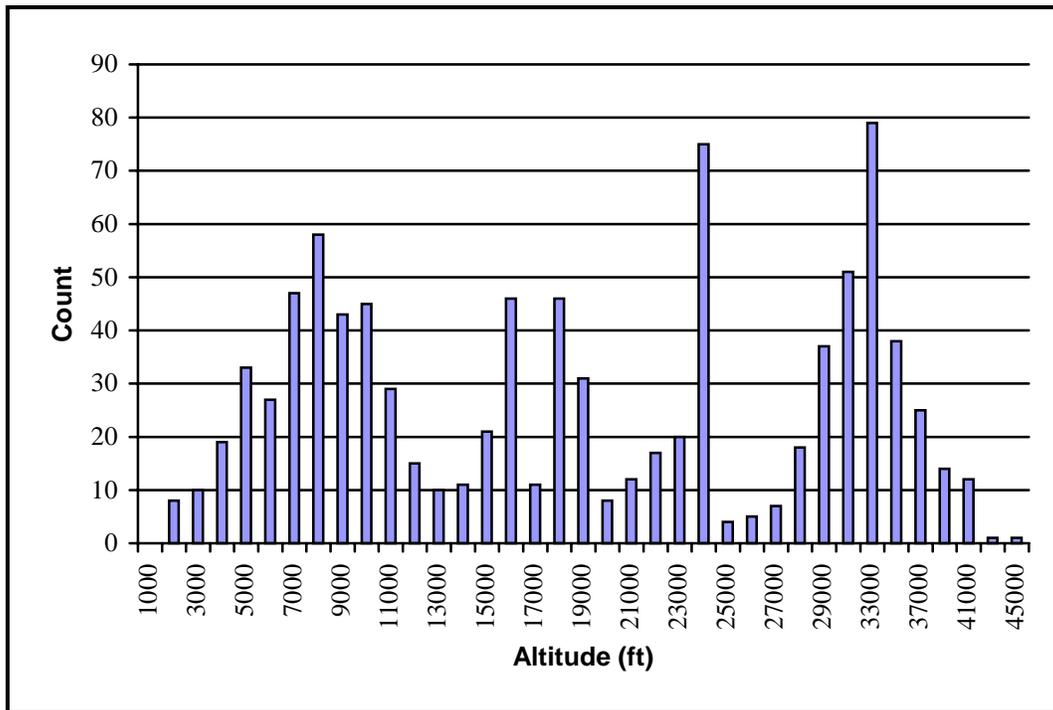


Figure 2: Airspace to Airspace Encounters by Altitude

5.3 Count by Vertical Phase of Flight and Encounter Angle

This section corresponds to Section 3.2.2.3 in Reference[1].

Table 7: Count of Airspace Encounters by Angle and Vertical Phase of Flight for Side Conflicts

Vertical Phase	Encounter Angles (deg)			Total
	[0, 30)	[30, 60)	[60, 90)	
Climb	3	4	16	23
Cruise	15	36	48	99
Descend	4	9	6	19
Total	22	49	70	141

Table 8: Count of Airspace Encounters by Angle and Vertical Phase of Flight for Top and Bottom Conflicts

Vertical Phase	Encounter Angles (deg)			Total
	[0, 30)	[30, 60)	[60, 90)	
Climb	9	0	0	9
Cruise	3	0	0	3
Descend	8	0	0	8
Total	20	0	0	20

Table 9: Count of Airspace Encounters by Vertical Phase of Flight with Unknown Angles

Vertical Phase	Count
Climb	15
Cruise	13
Descend	0
Total	28

6 Air Traffic Distributions

This section provides metrics that characterize the air traffic. The metrics are flight density partitioned by standard flight levels, flight type and sector penetration, statistics on the number of active flights, ground speed statistics, counts of interim altitude and amendment messages, and air traffic maneuvers by altitude and phase of flight. This section corresponds to Section 3.3 of Reference[1].

6.1 Air Traffic Density

This section corresponds to section 3.3.1 of Reference[1]. Detailed statistics on aircraft encounters are provided in Appendix A.

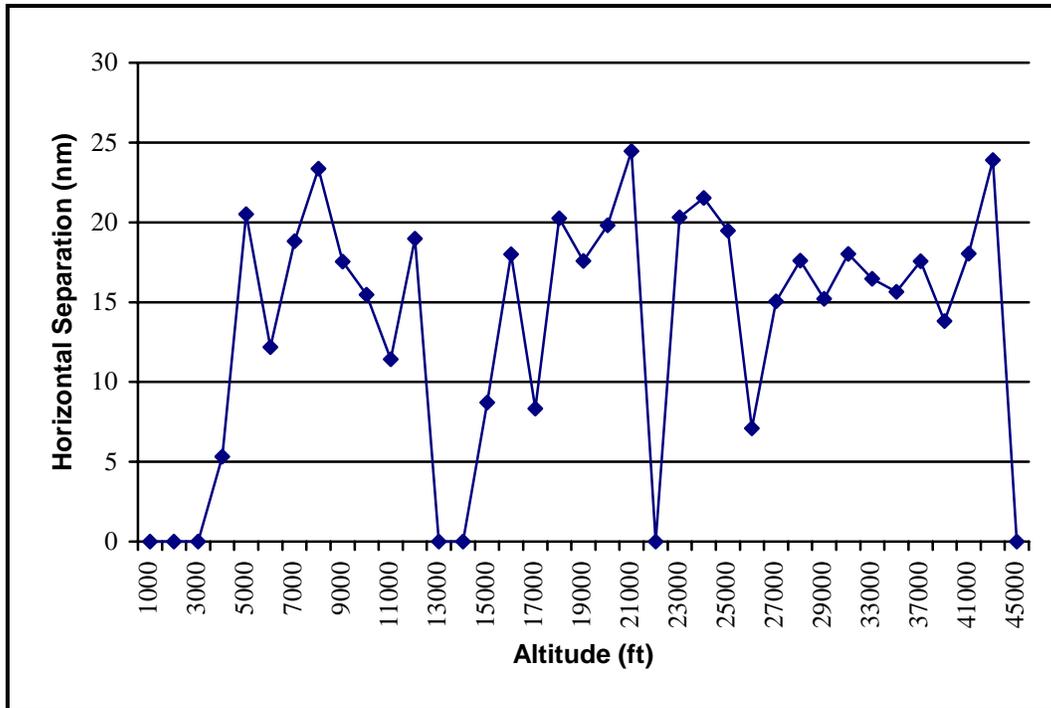


Figure 3: Average Horizontal Separation by Altitude for All Hours

6.2 Active Flights

This section corresponds to section 3.3.2 of Reference[1].

Table 10: Statistics on Active Flights per Minute Increment

Count Average	Standard Deviation	Maximum Count	Minimum Count
143.380	79.963	219	0

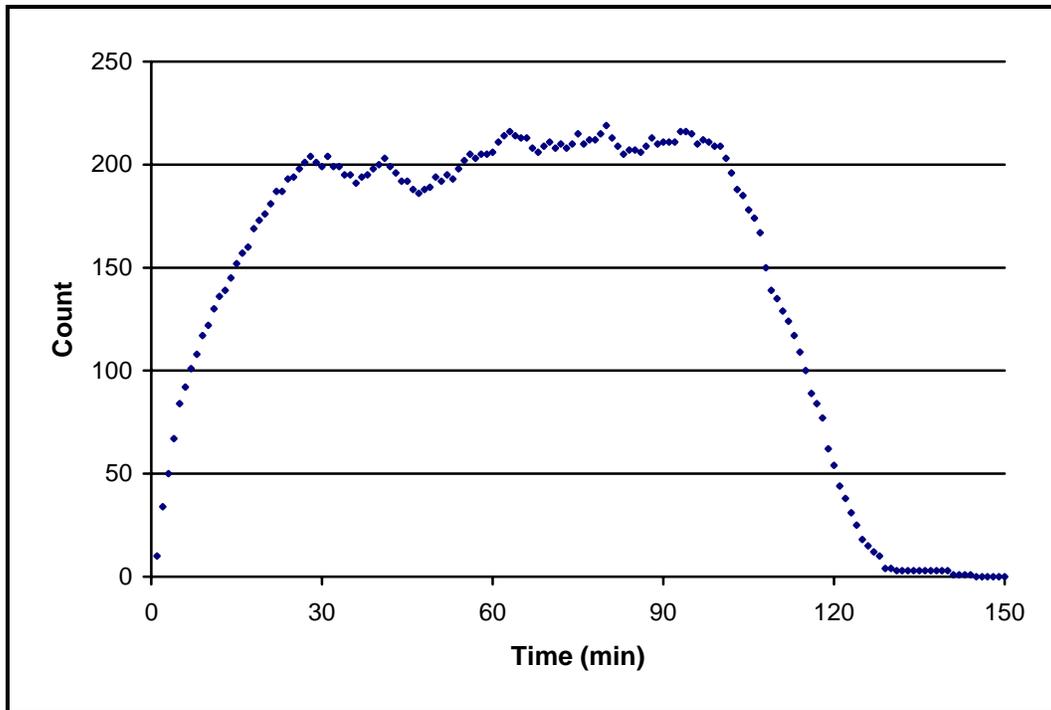


Figure 4: Count of Active Flights per Minute Increment

6.3 Flight Type and Sector Penetration

This section corresponds to Section 3.3.3 of Reference[1].

Table 11: Statistics on Sector Time, Center Time and Sector Penetration by Flight Type

Metric	Arrivals	Departures	Internals	Overflights	All Flights
Average Number of Sectors Penetrated	1.769	2.053	1.846	2.245	2.120
Average Time in Center (sec)	1094.017	1197.067	1164.615	1530.855	1398.267
Average Time in Sector (sec)	586.860	547.273	640.000	669.115	642.265
Percentage by Flight Type	17.900	11.500	4.000	66.400	100.000

6.4 Ground Speed

This section corresponds to Section 3.3.4 of Reference[1]. Detailed statistics on aircraft ground speed are provided in Appendix B.

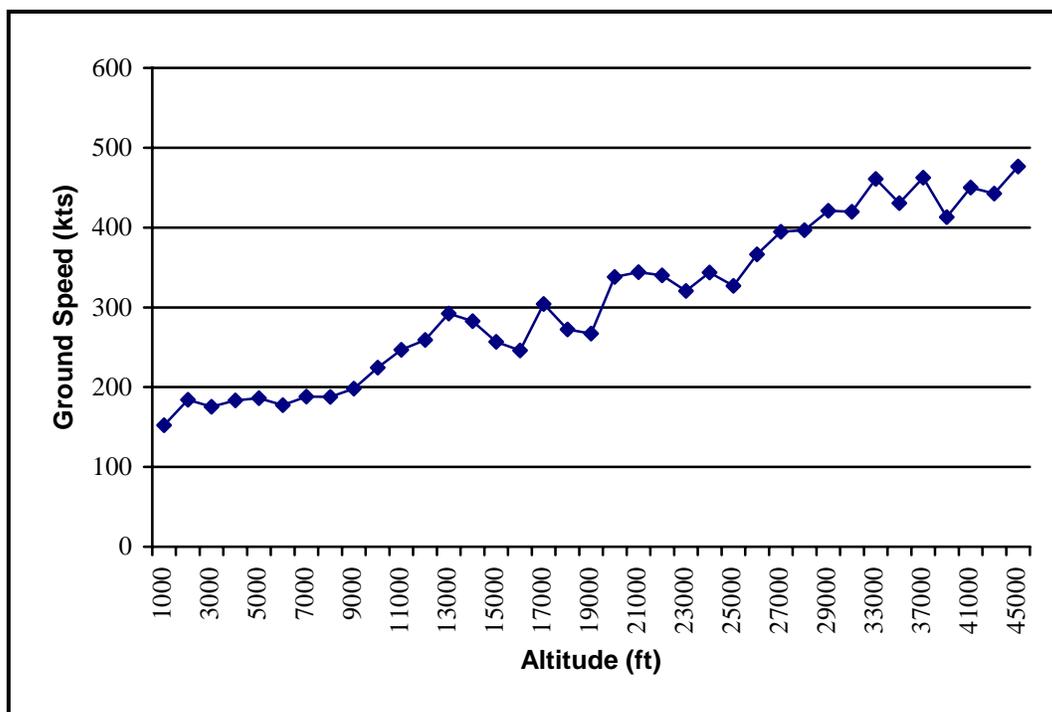


Figure 5: Average Ground Speed by Altitude for All Hours

6.5 Center to APD Ratio

This section corresponds to Section 3.3.5 of Reference[1].

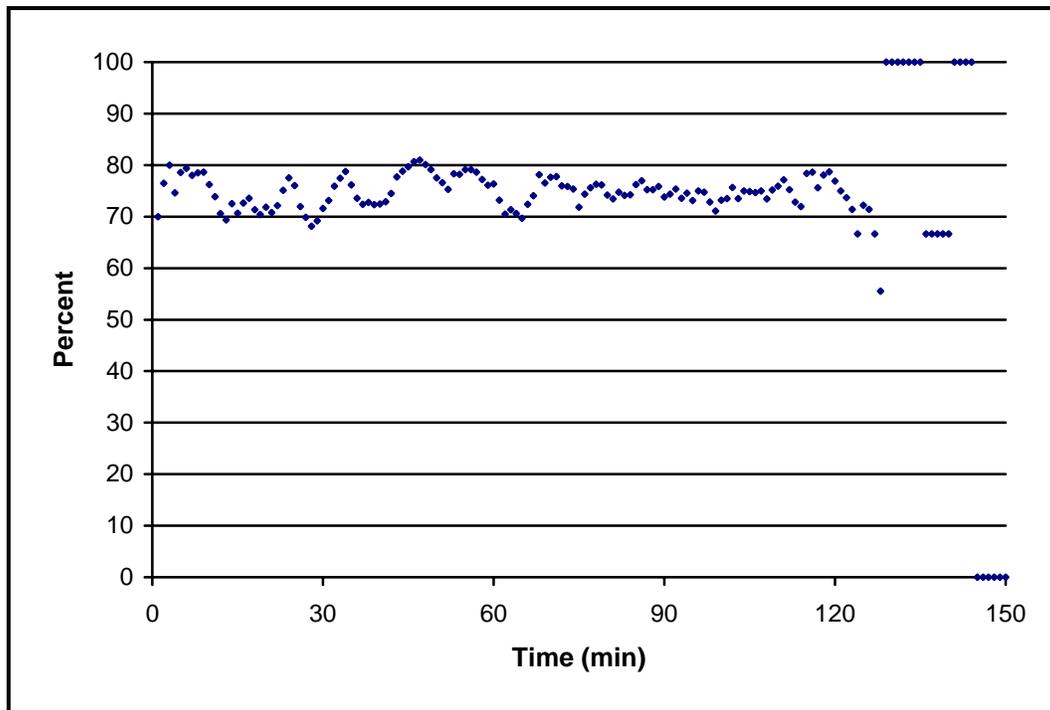


Figure 6: Percentage of Track Points in Center to APD Zone per Minute Increment

6.6 Interim Altitude Messages

This section corresponds to Section 3.3.6 of Reference[1].

Table 12: Statistics on Interim Altitude Messages⁵

Flight Count	Average	Standard Deviation	Maximum Count	Minimum Count
447	2.680	0.972	6	1

6.7 Amendment Messages

This section corresponds to Section 3.3.7 of Reference[1].

Table 13: Statistics on Amendment Messages per Flight⁶

Flight Count	Average	Standard Deviation	Maximum Count	Minimum Count
236	1.843	1.169	7	1

⁵ Statistics on flights with interim altitude messages only

⁶ Statistics on flights with flight plan amendments only

6.8 Air Traffic Maneuvers

This section corresponds to Section 3.3.8 of Reference[1]. Detailed statistics on air traffic maneuvers are provided in Appendix C.

Table 14: Total Track Report Maneuver Count by Vertical and Horizontal Phase of Flight

Vertical Phase	Horizontal Phase of Flight		Total
	STR	TURN	
ASC	1	826	426
DES	2	914	512
LEV	1	200	777
Total	4	1940	1715

Table 15: Percent breakdown of Flight Tracks by Vertical and Horizontal Phase

Vertical Phase	Horizontal Phase of Flight		Margin (%)
	STR (%)	TURN (%)	
ASC	0.027	22.574	11.643
DES	0.055	24.980	13.993
LEV	0.027	5.466	21.235
Margin (%)	0.109	53.020	46.871

7 Aircraft Distributions

This sections provides the metrics used to characterize the aircraft provided in the scenario. The selected metrics are aircraft type, model, navigational equipment, and the air carriers operating in the airspace. The section corresponds to Section 3.4 of Reference[1].

7.1 Aircraft Type

This section corresponds to Section 3.4.1 of Reference[1].

Table 16: Count by Aircraft Type

Aircraft Type	Count	Percentage of Total
J	450	68.702
P	87	13.282
T	88	13.435
Unknown	30	4.580
Total	655	100.000

7.2 Aircraft Models

This section corresponds to Section 3.4.2 of Reference[1]. A full listing and count of aircraft models is provided in Appendix D.

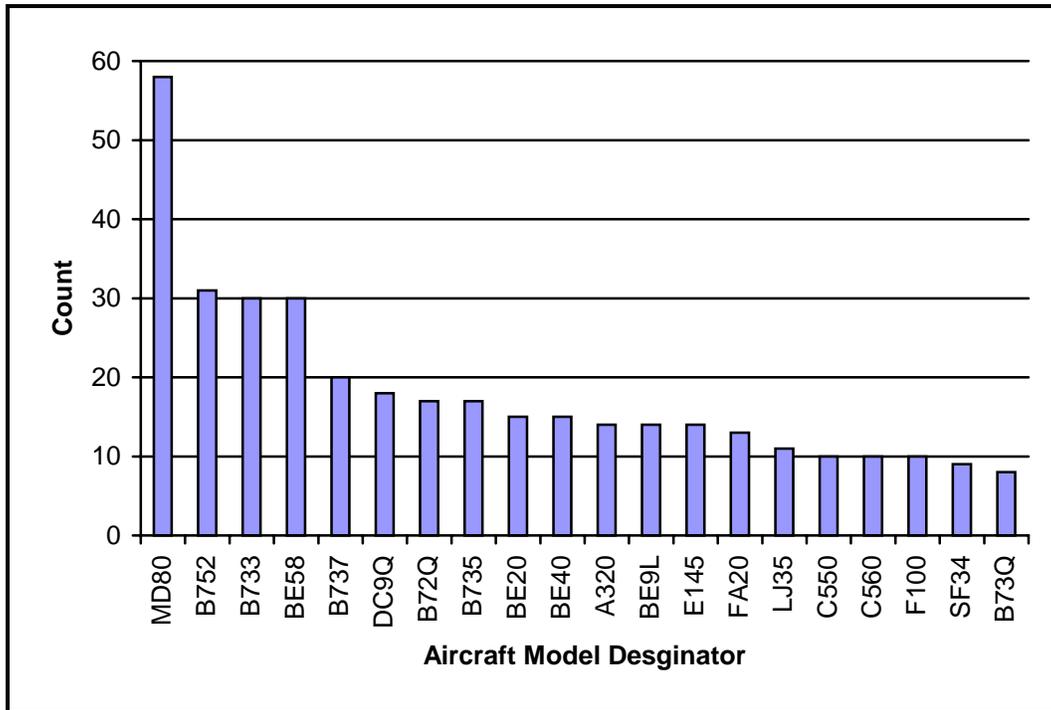


Figure 7: Count of Top Twenty Aircraft Models

7.3 Navigational Equipage

This section corresponds to Section 3.4.3 of Reference[1].

Table 17: Count by Aircraft Navigational Equipage Type

Nav. Equip. Designator	Count	Percentage of total
G	178	27.176
I	137	20.916
A	129	19.695
E	99	15.115
F	60	9.160
R	22	3.359
U	12	1.832
Q	9	1.374
P	5	0.763
W	3	0.458
Unknown	1	0.153
Total	655	100.000

7.4 Carrier Distribution

This section corresponds to Section 3.4.4 of Reference[1].

Table 18: Count by Carrier Type

Category	Count	Percentage of Total
Commercial	381	58.168
General Aviation	239	36.489
Other ⁷	35	5.344
Total	655	100.000

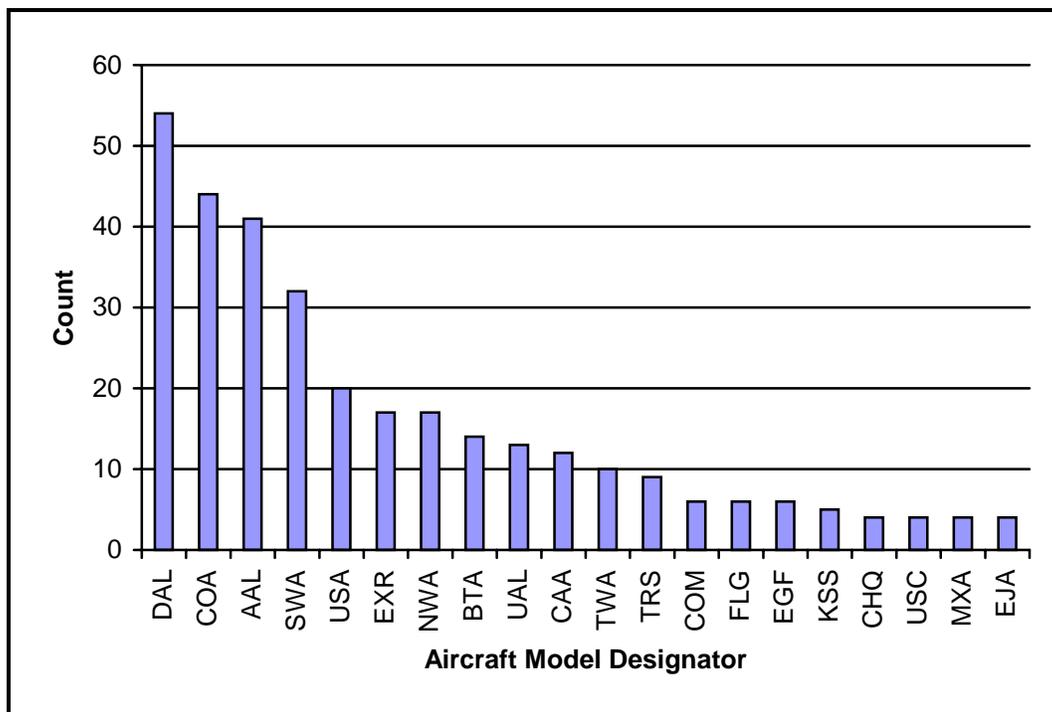


Figure 8: Count by Top Twenty Air Carriers

⁷ Includes military and aircraft with unrecognized designators

8 Flight Plan Adherence

This section provides statistics on lateral and vertical flight plan adherence and corresponds to Section 3.5 of Reference[1].

8.1 Lateral Flight Plan Adherence

This section corresponds to Section 3.5.1 of Reference[1].

Table 19: Statistics on Lateral Flight Plan Adherence by Altitude⁸

Upper Altitude (ft)	Flight Count	Max. Dist. Out (nm)	Min. Dist. Out (nm)	Average Dist. Out (nm)	Standard Dev.(nm)
10000	7	146	13	23.746	29.759
18000	8	148	16	63.751	56.257
33000	24	153	13	31.113	25.742
45000	13	47	14	26.658	6.213
Total	52				

8.2 Vertical Flight Plan Adherence

This section corresponds to Section 3.5.2 of Reference[1].

Table 20: Statistics on Vertical Flight Plan Adherence by Altitude⁹

Upper Altitude (ft)	Flight Count	Max. Dist. Out (ft)	Min. Dist. Out (ft)	Average Dist. Out (ft)	Standard Dev.(ft)
29000	221	33400	317	4476.890	4108.613
45000	76	11000	692	4040.283	2371.206
Total	297				

⁸ Statistics determined on tracks out of lateral adherence only.

⁹ Statistics were determined on tracks out of vertical adherence only.

Appendix A: Supplement to Section 6.1 - Aircraft Traffic Density

Table 21: Statistics on Aircraft Encounters by Altitude Interval for All Hours

Upper Altitude (ft)	Aircraft Count	Avg. Horz. Sep.(nm)	Standard Dev.(nm)
1000	0	0.000	0.000
2000	0	0.000	0.000
3000	0	0.000	0.000
4000	3	5.320	3.378
5000	1	20.510	0.000
6000	7	12.182	8.820
7000	7	18.826	5.716
8000	5	23.355	8.328
9000	3	17.542	11.177
10000	4	15.470	6.394
11000	2	11.430	10.938
12000	1	18.981	0.000
13000	0	0.000	0.000
14000	0	0.000	0.000
15000	3	8.712	7.016
16000	3	18.006	7.227
17000	3	8.329	4.957
18000	6	20.247	8.779
19000	11	17.577	7.555
20000	7	19.820	8.071
21000	1	24.464	0.000
22000	0	0.000	0.000
23000	1	20.306	0.000
24000	7	21.524	5.651
25000	3	19.477	11.854
26000	4	7.102	7.726
27000	4	15.047	10.145
28000	7	17.611	6.627
29000	23	15.219	8.608
31000	47	18.029	7.476
33000	127	16.461	8.203
35000	87	15.643	8.230
37000	62	17.568	8.105
39000	12	13.806	7.206
41000	6	18.049	6.238
43000	1	23.898	0.000
45000	0	0.000	0.000
Total	458		

Appendix B: Supplement to Section 6.4 - Aircraft Ground Speed

Table 22: Statistics on Ground Speed by Altitude for All Hours

Upper Altitude (ft)	Distinct Aircraft	Average Speed (kts)	Standard Dev.(kts)
1000	4	152.310	31.452
2000	32	184.040	48.490
3000	77	175.435	55.994
4000	121	183.325	51.918
5000	154	186.282	46.967
6000	171	177.465	50.173
7000	175	188.173	47.424
8000	161	187.854	46.687
9000	157	198.044	54.247
10000	158	224.272	71.227
11000	154	246.828	72.926
12000	153	259.234	74.433
13000	152	292.169	66.243
14000	160	282.835	63.986
15000	160	256.693	67.126
16000	165	245.964	65.236
17000	156	304.204	75.831
18000	163	272.111	69.671
19000	156	267.100	73.736
20000	147	337.957	90.298
21000	146	344.080	84.577
22000	142	340.208	82.446
23000	144	320.617	94.045
24000	146	343.731	90.188
25000	147	326.781	88.020
26000	145	366.314	99.777
27000	155	394.499	80.412
28000	154	396.865	63.986
29000	170	420.904	74.451
31000	186	420.000	58.484
33000	219	461.001	41.648
35000	163	430.671	36.954
37000	115	462.463	44.931
39000	57	412.907	48.778
41000	27	450.204	44.085
43000	8	442.457	47.347
45000	2	476.241	19.322

Appendix C: Supplement to Section 6.8 - Air Traffic Maneuvers

Table 23: Count of Maneuvers by Altitude, Vertical and Horizontal Phase of Flight

Upper Altitude (ft)	Vertical Phase	Horizontal Phase of Flight	
		STR	TURN
1000	ASC	2	2
	DES	0	1
	LEV	2	3
2000	ASC	15	13
	DES	6	5
	LEV	10	13
3000	ASC	37	28
	DES	16	21
	LEV	41	36
4000	ASC	41	36
	DES	34	30
	LEV	70	33
5000	ASC	46	28
	DES	48	36
	LEV	101	41
6000	ASC	59	32
	DES	45	36
	LEV	114	25
7000	ASC	53	28
	DES	46	21
	LEV	108	23
8000	ASC	31	19
	DES	49	16
	LEV	102	19
9000	ASC	20	13
	DES	56	23
	LEV	97	14
10000	ASC	42	17
	DES	55	18
	LEV	97	25
11000	ASC	15	10
	DES	59	10
	LEV	94	16
12000	ASC	8	5
	DES	60	7
	LEV	98	11

13000	ASC	5	3
	DES	62	3
	LEV	98	7
14000	ASC	8	7
	DES	63	6
	LEV	104	11
15000	ASC	10	5
	DES	61	5
	LEV	104	8
16000	ASC	27	15
	DES	67	5
	LEV	105	14
17000	ASC	16	9
	DES	63	5
	LEV	101	10
18000	ASC	31	17
	DES	68	6
	LEV	105	11
19000	ASC	24	11
	DES	60	10
	LEV	99	10
20000	ASC	18	8
	DES	63	7
	LEV	93	9
21000	ASC	9	6
	DES	58	8
	LEV	96	11
22000	ASC	6	5
	DES	57	7
	LEV	91	9
23000	ASC	14	9
	DES	61	8
	LEV	88	10
24000	ASC	32	15
	DES	56	7
	LEV	93	9
25000	ASC	13	7
	DES	60	9
	LEV	89	13
26000	ASC	15	11
	DES	59	9

	LEV	91	16
27000	ASC	26	10
	DES	63	6
	LEV	94	21
28000	ASC	26	10
	DES	66	12
	LEV	95	13
29000	ASC	66	34
	DES	77	14
	LEV	96	13
31000	ASC	66	42
	DES	80	22
	LEV	100	18
33000	ASC	146	116
	DES	71	22
	LEV	99	17
35000	ASC	106	82
	DES	61	19
	LEV	66	13
37000	ASC	90	67
	DES	41	9
	LEV	43	5
39000	ASC	45	31
	DES	20	3
	LEV	18	4
41000	ASC	24	20
	DES	8	0
	LEV	10	1
43000	ASC	6	4
	DES	6	0
	LEV	2	0
45000	ASC	2	2
	DES	1	0
	LEV	0	0

Appendix D: Supplement to Section 7.2 - Aircraft Models

Table 24: Count and Percentage of Aircraft by Model Type

Model Type	Aircraft Count	Percent of Total
MD80	58	8.855
B752	31	4.733
B733	30	4.580
BE58	30	4.580
B737	20	3.053
DC9Q	18	2.748
B72Q	17	2.595
B735	17	2.595
BE20	15	2.290
BE40	15	2.290
A320	14	2.137
BE9L	14	2.137
E145	14	2.137
FA20	13	1.985
LJ35	11	1.679
C550	10	1.527
C560	10	1.527
F100	10	1.527
SF34	9	1.374
B73Q	8	1.221
C210	8	1.221
CL60	8	1.221
H25B	8	1.221
A319	7	1.069
C650	7	1.069
CRJ2	7	1.069
DC9	7	1.069
E120	7	1.069
B712	6	0.916
B763	6	0.916
C414	6	0.916
C441	6	0.916
CRJ1	6	0.916
LJ31	6	0.916
SBR1	6	0.916
B734	5	0.763
C310	5	0.763

GLF4	5	0.763
PA32	5	0.763
AC90	4	0.611
B52	4	0.611
B738	4	0.611
B762	4	0.611
BE10	4	0.611
BE30	4	0.611
BE55	4	0.611
SW4	4	0.611
WW24	4	0.611
A340	3	0.458
AT72	3	0.458
B350	3	0.458
B744	3	0.458
BE36	3	0.458
C172	3	0.458
C525	3	0.458
E135	3	0.458
FA50	3	0.458
LJ25	3	0.458
LJ55	3	0.458
LJ60	3	0.458
MD11	3	0.458
PAY1	3	0.458
T37	3	0.458
T38	3	0.458
ASTR	2	0.305
B722	2	0.305
B732	2	0.305
C130	2	0.305
C17	2	0.305
C182	2	0.305
C421	2	0.305
C501	2	0.305
C82R	2	0.305
CL64	2	0.305
DC10	2	0.305
FA10	2	0.305
H25C	2	0.305
H60	2	0.305
J328	2	0.305

K35R	2	0.305
LJ24	2	0.305
MU30	2	0.305
P32R	2	0.305
PA31	2	0.305
STAR	2	0.305
A306	1	0.153
A310	1	0.153
A330	1	0.153
AA5	1	0.153
AC50	1	0.153
B772	1	0.153
BA46	1	0.153
BE35	1	0.153
BE60	1	0.153
BE76	1	0.153
BE9T	1	0.153
C135	1	0.153
C141	1	0.153
C206	1	0.153
C208	1	0.153
C402	1	0.153
C500	1	0.153
CARJ	1	0.153
CVLP	1	0.153
F2TH	1	0.153
F50	1	0.153
F90	1	0.153
F900	1	0.153
GLS2	1	0.153
H25A	1	0.153
H47	1	0.153
HS25	1	0.153
JS31	1	0.153
JS41	1	0.153
L101	1	0.153
LJ45	1	0.153
LR24	1	0.153
M20P	1	0.153
M20T	1	0.153
PA27	1	0.153
PA28	1	0.153

PA34	1	0.153
PAY2	1	0.153
PAZT	1	0.153
S601	1	0.153
SW4A	1	0.153
T2	1	0.153
T45	1	0.153
Unknown	1	0.153
Total	655	100.000